SALIVARY RESPONSE WHEN FOOD-DEPRIVED: COMPARING DIETERS AND NON-DIETERS

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ABSTRACT

This study examined salivary, cognitive and emotional reactivity to food cues when both non-food-deprived and food-deprived. Ten women low-restrained eaters, and ten women high-restrained eaters identified with the Revised Restraint Scale, participated in the study. Two sessions, one requesting subjects to consume a standard breakfast before coming into the session two hours later, and the other requesting subjects to fast for seventeen hours overnight, were attended one week apart. While at baseline, salivary reactivity did not differ significantly, there was a trend for an interaction effect across group and condition for salivary reactivity. There was a significantly higher urge to eat in the non-food-deprived condition, at baseline. There was a significant interaction effect for perception of smell and for amount of calories consumed, between the high-restrained eaters and low-restrained eaters, across conditions. These findings may highlight the cognitive, physiological and behavioural challenges faced by dieters. In addition, it may provide preliminary evidence that differences between dieters and non-dieters are, at least in part, the result of long-term dieting histories, rather than current dieting patterns.

CHAPTER ONE

INTRODUCTION

1. DIFFERENCES IN SALIVATION AS A FUNCTION OF RESTRAINT

The prevalence of both dieting and eating disorders has risen over more recent years (French & Jeffery, 1994) and, with it, an increasing understanding of eating behaviours formed by new theoretical models (Stunkard, 1984). Some of these developing models have evolved in an attempt to integrate the physiological responses to food with the thoughts and emotions related to food stimuli in a way that will better predict and explain eating behaviour. These theoretical models which form this area of research involve concepts related to salivation, and food-deprivation in the form of dieting (restraint).

1.1. Salivation

Salivation has more recently been utilised as one measure which may assist in the understanding of the types of physiological responses a person may have to food. Salivation represents a cephalic phase autonomic reflex which is elicited by the sensory properties of food (Tepper, 1992).

A commonly held assumption is that salivation is directly related to the degree of hunger a person is experiencing. Therefore, if a person becomes food-deprived, then it is to be expected that they would become increasingly hungry, salivate more to food cues, and consequently eat significantly more food (Tepper, 1992). Within the experimental setting, LeGoff, Leichner and Spigelman (1988) hypothesised that an increase in saliva would be associated with an increase in subjectively experienced hunger. Wooley and Wooley (1981) tested this empirically, utilising self-report measures of hunger, as did Booth and Fuller (1981). They both found that salivation was correlated with hunger. The positive relation between salivation and hunger demonstrated in research findings has been applied to the theoretical underpinnings of research on the salivary response (e.g., Rogers & Hill, 1989).

The data from other studies do not, however, confirm these findings. Sahakian, Lean, Robbins and James (1981) found that hunger ratings did not correlate with salivation. Jansen, Boon, Nauta, van den Hout (1992) went as far as to report a decrease in self-reported hunger with an increase in salivation, concluding that "hunger is an epiphenomenon of salivation" (1991:166) and that the relationship is more complex than at first assumed. Research by Wisniewski, Epstein and Caggiula, (1992) suggested that, while it appears that salivation is positively related to hunger and negatively associated with satiety, the salivary response can be elicited after satiety by the presentation of a

new palatable food. Overall, among these researchers, salivation and hunger appear to be "loosely coupled systems" (Jansen et al., 1992:163).

Challenges to this basic assumption are not new and can be traced back to the person that helped revolutionise the concept of salivary reactivity. Pavlov hypothesised that salivary responses to food do not indicate a desire to eat, but merely indicate that attention is focused on food (see Wooley & Wooley, 1981).

Nirenberg and Miller (1982) proposed that one possible reason why research indicated that salivation did not correlate with hunger was that a self-reported measure may not have accurately represent an internal state. While this may have been so, research does suggest that, even though a certain level of hunger may be a pre-requisite for the appearance of a well-established conditioned salivary reaction (Wooley & Wooley, 1981), this relationship may not be as simple as first thought and may be modified by, for example, the predictive power of the exposure to food cues and the likelihood of intake (Jansen et al, 1992).

1.2. Dieting and Deprivation

Since dieting involves the conscious limitation of food, dieters are assumed to be in a state of hunger. As a result, dieters who engage in years of dieting may be chronically food-deprived. It is this state of deprivation, that is a central theme in research by Herman and Mack

(1975). Unlike earlier research by Nisbett (1968) which suggested that body weight predicted restraint, Herman and Mack (1975) concluded that deprivation, not body mass, was the critical determinant of eating behaviour. Over more recent years there appears to be a general consensus that there is a substantial variation of eating behaviours in dieters and non-dieters, irrespective of weight (Herman, Polivy, Klajner & Esses, 1981; Klajner, Herman Polivy & Chhabra 1981; LeGoff & Spigelman, 1981; Ogden & Wardle, 1991).

The Theory of Restraint was originally introduced by Herman and Mack (1975) to explain the influence of chronic food restriction on eating behaviour. In their research, subjects who engaged in attempts to reduce their dietary intake (i.e. restrained eaters) were shown to increase their consumption of food when under the influence of disinhibiting conditions (e.g. dysphoric mood, dietary violations and/or alcohol). They concluded that restrained eaters appeared under sensitive to "internal" food cues and oversensitive to "external" food cues (e.g., the presence of attractive food).

Criticism of the original model were directed at both the implied passivity of subsequent eating behaviours and, perhaps more fundamentally, at the assertion that dieters are oversensitive to external food cues. Wooley and Wooley (1981) and more recently, Ogden and Wardle (1991), Piacentini, Schell and Vanderweele (1993) and Tepper (1992); believed that the cognitive and subsequent behavioural

consequences involved in restrained eating are not the result of passive processes, but rather, are a function of conscious, active, thought mechanisms. In addition, Piacentini et al. (1993) challenged the assumption of externality given by this model. They supplied empirical evidence that restrained eaters reported less food odour than unrestrained eaters, and they took this to mean that restrained eaters (and, perhaps more especially, the strict dieters) disattend to external food cues. Tepper (1992), likewise, provided empirical evidence that, while restrained eaters demonstrated an enhanced salivary reactivity, responsiveness to sensory properties of food were not heightened. A study investigating sensory aspects of food in women with anorexia, has similarly reported that there is no evidence for the hypothesis that this population of restrainers have elevated hedonics (Simon, Bellisle, Monneuse, Samuel-Lajeunesse and Drewnowski, 1993).

More recently, modifications to the concept of restraint have been developed in an attempt to improve its construct validity. LeGoff et al. (1988) provided empirical evidence to suggest that dietary restraint alone was insufficient to account for the differences amongst dieters, when they compared women with anorexia and women with bulimia. They concluded that there appeared to be *two* important factors related to eating behaviour: that is, dietary restraint and dietary variability. Dieters who participated in a highly variable eating pattern (the "fence sitter") were suggested to be different than those dieters who had a low

variability in their eating pattern (the "dieting drone")(Herman et al, 1988). A slightly different perspective was taken by Lowe (1994). Lowe divided restrained eaters according to the type of current dieting pattern they were participating in. He suggested that those restrained eaters who are currently dieting will have a different salivary response than those who are not currently dieting. Similarly, Eldredge (1993) and Rogers and Green (1993) challenged the viewpoint that restraint was equated with dieting. They suggested that only a portion of restrained eaters are likely to be restricting their intake at any one time. In addition, Heatherton, Polivy and Herman (1991) suggested concern for dieting, along with weight fluctuations, are central components of restraint, whereas, Ogden and Wardle (1991) suggested that a valuable distinction can be made by categorising according to whether a dieter is able to successfully or unsuccessfully inhibit food intake. They believed this measure, gauged by the tendency to binge, may influence susceptibility to disinhibit.

1.21 Measurement of Restraint

There are three common scales which have been constructed to measure restraint (Allison, Kalinsky & Gorman, 1992), the principal device being the Revised Restraint Scale (RS), developed by Herman & Mack (1975). Two other scales, the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985) and the Dutch Eating Behaviour Questionnaire (DEBQ; van Strien et al., 1986) also distinguish individuals identified as having a restrained eating pattern. However, all

three scales fail to assess actual current dieting behaviour at the time of testing, a more recently recognised factor in assessing restraint (Lowe, 1994; Rogers & Green, 1993). Psychometric comparisons across the three scales reveal that the test-retest reliability was highest for the RS, internal consistency was highest for the DEBQ, and the TFEQ had the greatest discriminate validity with respect to social desirability (Allison et al., 1992). A review by French and Jeffery (1994) suggested that while the RS has been shown to be reliable, two measures, that of weight loss and of caloric intake, may not discriminate restrained and unrestrained eaters adequately.

Since, at a more fundamental level, dieting behaviour has not been consistently or clearly operationalised, the factor structures differ between psychometric tests, making comparisons difficult to make (French & Jeffery, 1994). While a study by Laessle, Tuschl, Kotthaus and Pirke (1989) has tentatively concluded that the DEBQ-R and the TFEQ-R measure "the actual restriction of food intake in everyday life" (1989:506) and the RS, concerns with weight fluctuations and body shape that may lead to a dieting behaviour, the concept of dietary restraint still needs to be investigated further, before current measurement strategies can be examined and further refined.

1.3 The Relation Between Restraint and Salivary Reactivity.

In more recent times, both salivary reactivity and restraint have been integrated into research designs in an attempt to better understand the interactive process of physiological and psychological mechanisms relating to dieting and eating disorders. From a theoretical perspective, research in this area may help determine the nature of the physiological mechanisms involved in chronic food-deprivation (Klajner et al., 1981). Clinically, it is hoped that research in this area will help establish a clearly defined criteria for ascertaining a person's response to food stimuli, and, therefore, predicting and assessing response to treatment programmes (LeGoff et al.,1988).

1.31 The application of the Restraint Theory (Herman & Mack, 1975) to salivary reactivity

Several investigators have highlighted the heuristic value of applying the Restraint Theory (Herman & Mack, 1975) to assist in understanding and predicting the salivary reactivity of dieters and those with an eating disorder. The acute hypersensitivity to food cues explicit in the model, has been taken to mean that dieters would generally salivate more in the presence of food (Piacentini et al., 1993). Rogers and Hill (1989) suggested that the model implies an exaggerated physiological response, or a heightened "...readiness for palatable food..." (Herman et al., 1981:357).

1.32. The application of a conditioning model to salivary reactivity

A Pavlovian conditioning model has also been applied to explain how a salivary response which repeatedly fails to be paired with food consumption, will eventually result in a decrease in saliva (Wooley & Wooley, 1981). Originally, criticism of the application of the model was directed at the suggestion that the model may only be relevant for those institutionalised dieters who adhere to an externally imposed dieting regime (LeGoff et al., 1988).

However, more recently, the conditioning model has been utilised to explain the differences between dieters. The "sporadic dieters" (Tepper, 1992) or similarly, the "fence sitters" (Herman et al., 1981) are hypothesised to salivate more to food cues, since salivation often predicts actual food consumption, whereas the "consistent" dieters (Tepper, 1992) or the "dieting drone" (Herman et al., 1981) are hypothesised to salivate less since salivation in the past has not reliably predicted food consumption. Since it is now recognised that dieters can fit either category depending on their current dieting status, more recently, research has utilised this factor as a differentiating characteristic (Lowe, 1994).

1.33. The application of other models to salivary reactivity

Other theoretical perspectives have also attempted to explain differences in salivary reactivity. A biological paradigm suggested that women with bulimia are often found to have enlarged parotid (Touyz,

Liew, Tseng, Frisken, Williams and Beumont, 1993) and submandibular glands (Kinzl, Biebl Herold, 1993) which may result in hypersalivation. Kinzl et al. (1993) tentatively suggested that non-purging binge eaters may also have a similar physiological response and that excessive carbohydrates are the most probable cause, but that gastrointestinal hormones, and toxic irritants from vomiting may also contribute. This process involves hyperstimulation of the salivary glands, followed by hypersalivation, and in the long term, hypertrophy of these glands. Tepper (1992) had another biological explanation. She suggested that since severe caloric restriction is known to depress hunger and appetite, it can, therefore, affect those dieters who are restricting their intake and consequently impact on responses to food stimuli.

Depression has also been utilised to explain differences in salivary reactivity in restrained and unrestrained eaters. Wooley and Wooley (1981) asserted that if diets cause depression and depression is associated with reduced salivation, then diets should cause a decrease in baseline salivation. There are two lines of evidence against this assumption. Ogden and Wardle (1991) reported that dieting, and more especially unsuccessful dieting, does not necessarily cause a low mood. In addition, there is evidence that depression is not related to salivary reactivity (Bulik, Sullivan, Lawson & Carter, submitted, b).

Anxiety is also thought to influence salivation. However, while much of the literature has focused on the influence anxiety may have on

consumption, relatively little is known about the relationship between anxiety and salivary reactivity. This may, in part, be due to an exclusion of measures of anxiety within design methodologies. Recently, findings from a study by Moret, Coudert, Bejat, Robin and Lissac (1993) may tentatively assist in the understanding of this relationship. They found that, in the absence of acute stress, there were no differences in salivary secretions between those subjects classified as "apathetic and under-motivated", "normally anxious" and "anxious". These results are supported by Bulik et al. (submitted, b) who failed to find a relationship between anxiety and salivary reactivity.

1.34 Research on the relation between salivary reactivity and restraint

The research so far into the salivary reactivity of food stimuli in restrained and unrestrained eaters has contributed to a state of confusion. Some researchers suggest an increase in salivary reactivity in restrained eaters, a few suggest a decrease, while others assert that there is no significant difference between these two groups.

Some researchers reported that restrained eaters salivated more in response to food. Klajner et al., (1981) deprived "obese" and "normal weight" dieters and non-dieters (classified using the RS) from eating for five hours. They measured salivary flow rate using a whole mouth suction method when subjects were presented with a standard portion of pizza and told that they "would be allowed to eat it shortly" (1981: 196). They reported a salivary response in dieters approximately

three times more than that of the non-dieters. Similarly, restrained eaters salivated more than twice as much as did the unrestrained eaters in a study by Tepper (1992) after a two-hour period of food-deprivation. The food stimulus used was pizza and subjects were told they "could consume the pizza at the end of the trial, if they wished to do so" (1992:306). In this study, ten male and ten female subjects were recruited, of which six women and five men were restrained eaters (identified using the TFEQ). LeGoff and Spigelman (1987) found similar results when they measured salivary reactivity to food odours in 40 subjects (20 males and 20 females) who had eaten their breakfasts two-hours prior to the experimental session. They used the Strongin-Hinsie-Peck (Peck, 1959) procedure to measure salivation. They reported that dietary restraint (measured using the short form of the RS) predicted increased salivary reactivity to food odours when deprived of food for two hours.

Other researchers, however, report that the degree of restraint did not predict salivary response to food (Bulik et al, submitted, a; LeGoff et al., 1988 and Rogers & Hill, 1989). Rogers and Hill (1989) measured salivation with the Strongin-Hinsie-Peck, (Peck, 1959) method in 34 "normal weight" women using imagery and real food stimuli (sandwiches and cakes individually chosen from a menu). It was made clear to subjects that "they were not going to be required to actually eat the food" (1989:393).They reported that restraint (as measured using the TEFQ)

was not significantly related to salivary reactivity. Since subjects were tested 40 minutes after food consumption, and since no other studies report testing so soon after consumption, comparisons with other studies are difficult. LeGoff et al. (1988) measured dietary restraint in females with anorexia (6), with bulimia (6) and in matched controls (12) with the RS. When food and non-food odours were presented, they discovered that restraint was not significantly correlated with salivation levels, either before treatment or 60 days into the treatment programme. In a study by Bulik et al. (submitted, a), there was no significant difference between the 19 low-restrained women (measured using the short form of the RS) and the 19 high-restrained women when an individual preference food was presented after two-hours of food-deprivation. Subjects were told that "the food was available for their consumption if they chose".

Conversely, Wooley and Wooley (1981) suggested that when food cues were present, dieters salivated less. This was demonstrated empirically, with a whole mouth suction salivation method (Wooley et al.,1978 as reported in Wooley & Wooley, 1981). They took this to be reflective of the conditionable nature of anticipatory salivary response, when dieters reduce their intake.

1.4 Baseline Levels of Saliva

Some studies recorded and comment on baseline or resting saliva rate. In comparisons between normal weight dieters; obese dieters

and non-dieters (Klajner et al, 1981); between women with bulimia, high-restrainers and low-restrainers (Bulik et al. submitted, a); between diet disordered (women with bulimia and anorexia) and controls (Touyz et al,1993); and between restrained eaters and non-restrained eaters (Tepper, 1992); there was no difference in saliva ratings when no food cues were present (baseline). Similarly, Rogers and Hill (1989) reported that degree of restraint was not significantly related to resting saliva in normal weight female subjects. Touyz et al.(1993), however, reported different mean salivary pH levels in both women with bulimia and anorexia than levels found in the controls.

Few studies investigated baseline recordings when subjects were deprived of food. Wooley and Wooley (1976; as reported in Wooley & Wooley, 1981) suggested that dieters who participated in a low-calorie diet over a period of a week had a progressively lower baseline saliva rate. They suggested that since dieting is associated with depression, and depression with a reduced saliva rate, then it can be assumed that diets could cause a decrease in spontaneous salivation. However, Wooley et al. (1978) reported that baseline levels were relatively stable three, six, and nine hours after food-deprivation. In this particular study, restraint was not reported to have been measured.

1.5. Salivary Reactivity in Eating Disordered Women.

Salivary reactivity to stimulus food in eating disorders has been examined, not only because women with anorexia and bulimia are hypothesised to represent two types of dieters, the "dieting drone" and the "fence sitter" (Herman et al.,1981) but also to help determine whether those with an eating disorder have a similar or different salivary response to food than those who diet and those who do not diet. Such information may help determine whether dieters and those with an eating disorder share the same underlying physiological responses to food.

One area of research is based on the hypothesis that eating disorders are at the extreme continuum of dieting behaviour, and, therefore, can be utilised as a clinical analogue to two proposed types of dieters: the "dieting drone" (as with women with anorexia) and the "fence sitter" (as with women with bulimia) (Herman et al, 1981). A conditioning model has been applied to predict salivary reactivity. For the women with anorexia, salivation is hypothesised to be an unreliable predictor of consumption, and as a result, salivary responses weaken. At the other end of the scale, women with bulimia frequently engage in binge episodes and, as a result, salivation is hypothesised to become a reliable predictor of food.

Results from studies are, as in other areas of restraint and salivation, contradictory. LeGoff et al. (1988) found that while six inpatient women with anorexia salivated less to food, the six bulimic

women inpatients salivated more to food before treatment. However, they found that 60 days into treatment the salivary reactivity of the women with eating disorders was more concordant with the salivary reactivity of controls. Treatment involved a combination of group psychotherapy, family therapy, cognitive therapy, behavioural therapy, and information therapy.

Conversely, Bulik et al. (submitted, a) investigated the response of women with bulimia with unrestrained and restrained women and found that bulimics salivated less to food than both of the other two groups. A pre- and post-treatment study of these bulimic women (Bulik, Sullivan, Lawson and Carter, submitted, b) found that prior to treatment salivation in women with bulimia did not increase on presentation of a palatable food. However, following treatment a positive salivary response occurred which was closer to that of controls.

1.6. Longer Term Food-Deprivation and Salivary Reactivity

Studies investigating salivary reactivity when a short-term energy reduction condition is applied, do not provide the opportunity to investigate what happens when the body starts to adapt to a lower energy intake over a longer term period. In addition, while it is assumed that dieters are already food-deprived, many restrainers are not currently dieting and are, therefore, not depriving themselves of food. Moreover, applying a period of food-deprivation beyond the four hours which

people commonly have between meals, may give an opportunity to see if restrained eaters and non-restrained eaters respond any differently when exposed to food stimulus. As unrestrained subjects in this case would be also undergoing modest food restrictions, a comparison of the different salivary responses may then assist in distinguishing between the short-term effects of deprivation and the longer term effects of dieting which many restrained eaters have participated in over many years.

For these reasons, some researchers have incorporated into their research design a period of partial or complete food-deprivation longer than the standard two-hour period included in many studies. For example, Rosen (1981) compared "obese" dieters between an initial two-week baseline period where they were fed a weight-maintaining diet and a six-week period where they were fed a standard weight reduction diet consisting primarily of lean meat, fish or fowl. Overall, results suggest that subjects had a lower salivary response when they switched from moderate to marked caloric reduction, when exposed to pizza. Subjects were told that they "would not be able to eat the pizza afterwards, but would have their scheduled dinner" (1981:367). Since only obese dieters were investigated, results cannot be easily generalised to the non-obese dieting population.

Conversely Wooley, and Wooley (1973) have shown that the amount of salivation increased in response to dietary deprivation and palatability. Wooley et al. (1978) utilised imagery to measure salivation

three, six and nine hours after deprivation in a group of nine controls. They found that salivary responses leveled off after six hours. However, they also found that appetite for less palatable food increased six hours after eating and continued to rise up to nine hours.

Sahakian et al. (1981) applied a completely different methodology when they deprived their 10 male and 4 female non-obese subjects of food for 17 hours. On presentation of a standard food cue, they found that saliva significantly increased with increased restraint (scored on the RS). Unlike other studies which have used standard saliva collection methods, saliva measures were taken by requesting subjects to empty their mouths of saliva into a cup. In addition, subjects were not tested individually, but the experimental session was run as a group.

Taking a slightly different approach, Piacentini et al. (1993) investigated another autonomic response to food. In their study, skin conductance-orientating responses were measured to food odours when either fasted overnight (13-20 hours) or satiated (half-an-hour after a standard breakfast). They used the TFEQ (Stunkard and Messick, 1985) to measure restraint. They found that the unrestrained group had a significantly larger skin conductance orientating response when exposed to food odour.

1.7. Methodological Issues

Although results in all these areas of research appear contradictory, the differences are probably, in part, a function of the different methodologies utilised (Wooley and Wooley, 1981).

The most recognised difference between studies is in the different methods utilised to measure saliva flow rate (Wooley & Wooley, 1981).The two main methods used were the whole-mouth suction [e.g., the Carson Crittendon vacuum cup, which is attached to the parotid gland (Shannon, Prigmore and Chauncey, 1962)] versus the dental rolls [Strongin-Hinsie-Peck (Peck, 1959)]. A review by Wooley and Wooley (1981) revealed that the "dental roll" method yielded more reliable results. Other less common methods were also utilised, for example, Tepper (1992) used a method by Navazesh and Christensen (1982) which involved empting the contents of the mouth into a cup.

Another major methodological issue centres around what subjects were instructed to do with the food. Although some research projects indicated that the food would not be presented for consumption (LeGoff and Spigelman, 1981; Rogers and Hill, 1989), others gave the instructions that either subjects would eat (e.g., Wooley, Wooley & Williams, 1978) or could eat the food (e.g., Tepper, 1991; Bulik et al., submitted, a & b). It is thought that the instructions to eat the types of food usually prohibited in a self-imposed diet may increase anxiety and thus alter salivation rates (Herman, et al., 1981). Conversely, it is also

possible that instructions not to eat may also inhibit the salivary response, since there is no likelihood that the food will be consumed (Jansen et al., 1992). Unless cognitive and emotional measures are collected alongside salivary measures, then these varying hypotheses will remain untested. However, in the more recent past, many methodological manipulations have focused on controlling for how people feel and think (that is, attempts to reduce anxiety and to avoid cognitive inhibitory processes involved with the prediction of food consumption). Most of the studies underplay the importance of using measures of anxiety and cognitions along with measures of salivation, to give a more composite, complete analysis of the reactivity to food stimuli. Only few studies have incorporated such measures within their methodologies (e.g., LeGoff et al., 1988; Bulik et al., submitted, a & b).

The degree of satiation or hunger has been mentioned as another differing factor impacting on the results of various studies (Herman et al., 1981). However, many studies (Bulik et al., submitted, a & b; Tepper, 1992; LeGoff & Spigelman, 1987; Wooley & Wooley, 1978) have used a standard two-hour period after consumption of food before proceeding with the experimental session. Regardless, differences in reported salivary reactivity have occurred.

Other methodological variables mentioned within the literature include different subject pools and, therefore, the possibly different restrained eaters, (e.g., "self-monitored" eaters versus "institutionalised"

eaters; LeGoff & Spigelman, 1987). Jansen et al., (1992) concluded that in fact all dieters have their own individual learning histories, and it is these histories which are the main factors involved in the different contingencies they engage in and, subsequently the different eating behaviours and salivation rates they display.

The type of food stimulus used may also account for variations in results. Some use real food odours (e.g., LeGoff, et al., 1988), and or visual cues (e.g., Klajner et al., 1981), while others use imaginary exposure (e.g., Wooley & Wooley, 1981). While imaginary exposure is perhaps not as threatening, it is also not such a powerful stimulus (Herman, et al., 1981). However, though the different food stimuli utilised may prove problematic when comparing different research results, these varying approaches may provide a more complete analysis of what goes on outside the four walls of the laboratory. In the environmental setting, food stimuli may be purely olfactory, visual or both, depending on situational cues (e.g., the food may be viewed in a magazine or behind a shop window). Similarly, the food may or may not be available (depending on, for example, whether or not there is money available). Since this is the case, the varying methodologies utilised by a number of studies may not be conflicting, but rather give a more complementary account of what it may be like for the dieter when faced with any number of situations involving food.

The type of food utilised may also make a difference. Many

researchers have used standard food cues for all their subjects and most of these foods are high calorie or sweet foods (e.g., hot pizza and chocolate chip cookies, Klajner et al., 1981). Only few studies have provided subjects with a choice of foods (e.g., Bulik et al., submitted, a & b; French, 1992; Nirenberg & Miller, 1982). Both French (1992) and Nirenberg and Miller (1982) have asserted that a choice of foods must be offered in order to provide a strong test of the extent to which restrained eaters respond.

2. INTAKE

2.1. The Relation Between Restraint and Intake

The Theory of Restraint (Herman & Mack, 1975) has contributed a great deal to understanding the relation between restraint and eating behaviour. It does seem that, in restrained subjects, the amount of food consumed during a preload does often predict the amount of food consumed after the preload. If a large amount is consumed during a preload, then a large amount will be consumed later. However, empirical evidence is not conclusive. Lowe (1994) reported that restrained eaters currently on a diet to lose weight, who were given a preload, subsequently consumed less than those restrained dieters who were given no preload. Ogden and Wardle (1991) gave their restrained and unrestrained subjects a high-calorie or a low-calorie

preload. They found that restraint did not significantly affect subsequent intake.

Banduras' self-efficacy model is also likely to assist in the understanding of intake in restrained subjects during moderate food-deprivation. This paradigm, which has been applied to the salivary response by Eldredge (1993) and Herman and Polivy (1991), asserts that self-perceptions influence eating behaviour. Since deprivation, whether through a self-imposed or externally-imposed diet regime, has successfully inhibited food intake, then diet boundaries are more easily maintained when exposed to food stimulus. Dieting behaviour is seen as successful (and this appears to be the case whether internally or externally imposed), which results in an increase in self-efficacy, and as a result, dietary control is both reinforced and maintained.

2.2. The Relation Between Salivation and Intake

According to the Restraint Theory (Herman & Mack, 1975) intake in restrained subjects is motivated by a self-imposed diet quota rather than feelings of hunger or satiety. This would imply that salivation in dieters would not necessarily predict the amount consumed. The question of the strength of salivation as a predictor of the likely amount consumed in both restrained and unrestrained eaters is an issue addressed within the literature (Herman et al, 1981). Klajner et al. (1981) found that an increased salivary response in restrained subjects did not

correspond with a bout of overeating. Rogers & Hill, 1989 reported in their study that the degree of salivation *was* positively correlated with amount consumed in restrained eaters. Eldredge (1992) investigated this relationship in more detail. He stated that generally changes in hedonics and salivation were related to increased food intake, but changes in hedonics without changes in salivation were not related to consumption.

3 THE RATIONALE FOR THE PRESENT STUDY

Salivary reactivity in dieters is a relatively new area which may supply valuable information, not only for accurately determining instrumental measures of appetite, but also for assisting with comparisons of physiological gustatory differences and similarities amongst those displaying similar eating patterns. However, as yet, there is little empirical evidence available. Not only this, but results from the few studies that are available appear contradictory in nature, which leaves more questions than answers.

3.1. The Specific Aims of This Study

1. The primary aim of the study is to examine the relation between dietary restraint and salivary response to food cues under conditions of food-deprivation.

The purpose of the food-deprivation is two fold. Firstly, it is designed to mimic the deprivation associated with a self-imposed diet, rather than to assume that restrained eaters are currently food-deprived. Secondly, it will help provide information on the type of response that non- dieters may have to food stimuli when they too are food-deprived. Such information may help elucidate the difference between the short-term effects of deprivation and the long-term effects of dieting.

Very few studies have put their subjects on low-calorie diets (Rosen, 1988) or fasts (Wooley et al., 1978; Sahakian et al., 1981 and Piacentini et al., 1993) and measured salivary reactivity to a food stimulus. Some of these studies do not utilise real (as opposed to imagined) food cues and none of these studies provide individually chosen food cues.

2. Another aim of this study was to examine the relation between dietary restraint and the cognitive and emotional responses to food cues when moderately food-deprived. Very few studies have included in their research design measurements of cognitive and emotional responses in conjunction with measurements of salivary reactivity, to food stimuli. Even fewer studies have measured the cognitive or emotional aspects involved with moderate food deprivation.

3. Finally, this study aims at examining the relation between dietary restraint, amount eaten and salivary response when moderately food-deprived. A state of confusion exists in this area, with researchers

suggesting that salivation is both positively and negatively correlated to consumption in restrained eaters. In addition, while many studies have established the amount of food eaten by weighing the food before and after consumption and then calculating the total grams consumed, very few studies go a step further and calculate calories consumed.

3.2. The Hypotheses

Hypothesis One is that, in line with previous findings, restrained and unrestrained subjects will have similar baseline salivary levels. In addition, it is hypothesised that restrained subjects are likely to have a higher tolerance for food-deprivation and, therefore, the additional deprivation produced by the fast would be less noticeable. As a result, it is predicted that salivary response will remain relatively the same from baseline in the restrained eaters, when food-deprived. Conversely, the unrestrained subjects will have a lower tolerance to food-deprivation and will, therefore, have increased internal hunger cues due to energy requirements resulting from the deprivation. This will, in effect, influence the attention that they place on their food. It is predicted that the increased attention will result in an increased salivary reactivity.

Hypothesis Two is that the urge to eat will differ on the non-food-deprived day between the restrained and unrestrained groups,

based on the assumption that the restrained subjects will have been on self-imposed dietary restrictions before the session commenced, and that this difference will be less marked on the food-deprived day, given that both groups will have under gone food-deprivation. Similarly, the perception of smell will be heightened in restrained subjects on the non-food-deprived day, but this difference will be less marked on the food-deprived day. Feelings of fatness, and guilt are predicted to be higher in restrained subjects, in line with the poor body image and cognitive distortions, recognised as a feature of dieting. However, since the externally-imposed diet will have created a sense of dietary success, these emotions are predicted to be less obvious on the food-deprived day. In addition, it is hypothesised that restrained eaters will feel less anxious when food-deprived, than when not food-deprived. However, their level of anxiety in both conditions is predicted to be at a higher level when compared with their unrestrained counterparts.

Hypothesis Three is that while unrestrained subjects may have an increase in the amount that they eat after the fast due to increased energy requirements, restrained subjects will have a decrease in the amount they eat in order to maintain the already successful externally imposed diet schedule. This relates to Banduras' self-efficacy model (see Polivy & Herman, 1991) which introduces motivational aspects of dieting.

The application of this model would predict that an externally-imposed food restriction would have the same effect as a self-imposed diet, and that the restrainers would thus perceive this as initial success and, therefore, increase their motivation to maintain their reduced eating pattern.

CHAPTER TWO

METHOD

1. SUBJECTS

Subjects were 20 women between the ages of 18-38. Ten of these women were designated as low-restrained eaters (LO) based on scores less than or equal to three on the short form of the Restraint Scale (RS; Herman & Mack, 1975) (mean =1.5, SD $\pm$ 1.0; Range = 0-3) and ten women designated as high-restrained eaters (HI) (Mean = 9.8; SD $\pm$ 1.1; Range = 9 -12) based on scores greater than or equal to nine.

All subjects were recruited from advertisements both at the University of Canterbury, and in a local newspaper. Subjects were told they would receive $10.00 in appreciation for their participation.

Subjects were excluded if they had ever met criteria for anorexia, bulimia or Eating Disorder, Not Otherwise Specified (ED-NOS)(assessed using the eating disorders section of the Structured Clinical Interview for DSM III-R: SCID; Spitzer, Williams, Gibbon & First, 1990). In addition subjects were excluded if they smoked, if they were on medication that could affect salivation (e.g., tricyclic antidepressants) or if they scored between, and including, 4-8 on the Revised Restraint

Scale (RS; Herman & Mack, 1975).

2. PROCEDURE

This study was approved by the University of Canterbury Human Ethics Committee. Written informed consent was obtained from all subjects (see Appendix A). Subjects were informed that they were participating in a study examining the human salivary response.

During the initial screening sessions, subjects underwent SCID diagnostic interviews, completed the Beck Depression Inventory (BDI; Beck, Ward, Mendelsohn, Mock & Erlbaugh, 1961) (see Appendix B) and the Revised Restraint Scale (Herman & Mack, 1975) (see Appendix C). They were then asked to provide hedonic ratings for 6-8 "favourite rich" foods. In addition, subjects were asked if they were "currently on a diet to lose weight ?". Subjects were introduced to the laboratory, and the one-way screen, and were given a practice at inserting the dental rolls for salivary collection.

Subjects participated in two 40-minute sessions, one week apart, held between 9.30 a.m. and 11.00 a.m. Prior to one session the subjects consumed a standard, caffeine-free, breakfast and were requested not to eat or drink anything for two hours before their arrival at the laboratory, and on the other session subjects fasted for a 17 hour period where only water or herbal teas were consumed. Ten subjects

participated in the fast first and ten subjects participated in the standard breakfast first. Urine samples were obtained from the subjects at the end of the 17 hour fast, in order to encourage adherence. All subjects claimed to have successfully completed the fast. The stimulus food presented was a standard portion which was individualised according to the list given during the screening session. Foods were chosen on the basis of having a high hedonic rating and good aromatic properties. The standard portion included a variety of three different foods (sweet and savoury).

The experiment took place in a comfortable chair, in a low stimulus room. The researcher occupied an adjoining room and gave instructions through a speaker system. Subjects were observed through a one-way mirror.

Subjects had the protocol explained to them, upon arrival to the laboratory. They rinsed their mouths out with water and were invited to relax in a recliner chair for ten minutes. The salivation protocol was that of Strongin-Hinsie-Peck (Peck, 1959). Subjects swallowed and then inserted three pre-weighed 1.5 inch cotton dental rolls. One of these rolls went under the tongue, and two to either side of the mouth between the lower cheek and teeth. The rolls remained in the mouth for a two-minute period and were then removed, by the subject, placed into a bag and then sealed. Subjects then completed several (0-8) self-report scales (see Appendix D). A six-minute break was preceded by swallowing and

then inserting another set of dental rolls. Immediately after the last roll was inserted, the portion of food was brought out and placed on the subject's knees. The subject was instructed to "look at the food, smell the food and think about how the food might taste". Once the dental rolls had been removed after the standard two-minute period, another (0-8) self-report scale was completed.

An appointment for the second session was made or if this was the last session, subjects were then debriefed. To debrief, subjects received written and verbal information about the study, and given the opportunity to ask questions or talk over any issues which may have arisen for them during the experimental sessions.

The sealed bags were weighed (to the nearest 0.001g) immediately after the session and the pre-weighed amount was subtracted from this amount in order to obtain a salivary flow rate.

3. ASSESSMENT PROCEDURES

3.1. Diagnostic Interview

The interview protocol was standardised with the implementation of the SCID screening instrument. It was designed to assess an eating disorder or an ED:NOS. In addition, all subjects were asked if they were "currently on a diet to lose weight ?", in order to ascertain their current dieting status.

3.2. Psychometric Tests

Verbal instructions were given for both the BDI and the RS tests. All items were read out aloud by the researcher and participants were then requested to circle the most appropriate responses.

3.21. The short form of the Restraint Scale.

The Restraint Sale (RS; Herman & Mack, 1975) was designed to assesses concern with weight loss and its maintenance, as well as weight history (including fluctuations). It has been reported to have a high internal consistency (Allison et al., 1992). The Restraint Scale has been found to have two factors: Concern for Dieting and Weight Fluctuation. Each item was read out by the interviewer and the response given by the subject was then recorded on the sheet.

3.2. The Beck Depression Inventory.

The Beck Depression Inventory (BDI; Beck, Ward, Mendelsohn, Mockand Erlbaugh, 1961) is a 21-item self-report scale used to measure severity or intensity of depression. The internal consistency and concurrent validity with the Hamilton Psychiatric Rating Scale for Depression (HRSD) were also high. Evidence indicates that the BDI differentiates depression from anxiety and sub-types effectively (Beck, Steer, Garbin & 1988).

CHAPTER THREE

RESULTS

1 DATA ANALYSIS

A series of individual analyses were conducted in order to examine (1) the salivary response between high restrained eaters (HI) and low restrained eaters (LO) when food-deprived and when non-food-deprived (2) the cognitive and emotional responses to food exposure over the food-deprived and non-food-deprived conditions (3) the caloric intake of the HI and LO groups over these two conditions.

Student's *t* tests were used to analyse continuous demographic, and psychometric variables. Variables which were non-normally distributed were analysed with Wilcoxin X^2 . Saliva data were non-normally distributed. Therefore log transformations for all salivary variables were utilised in the analyses. A repeated measures 2x2 analysis of variance was performed with diagnosis (HI or LO) as the between subject factors and condition (food deprived or non-food deprived) as the within subject factors. Salivary reactivity was defined as grams of saliva at food presentation minus grams of saliva at baseline. To calculate intake, all food types on each plate were weighed before and after being presented for consumption. The number of grams for

each food type was then multiplied by the number of calories per gram. (Caloric content of all foods consumed were determined using the United States Department of Agriculture Handbook 456; USDA, 1975.) A percent of available calories eaten was then calculated. All analyses were performed using JMP (SAS Institute Inc., 1994).

2. SUBJECT CHARACTERISTICS AND PSYCHOMETRICS

Demographic and psychometric comparisons are presented in Table 1. There was no significant difference in age or BDI between the two groups. There was a significant difference between the two groups on BMI (kg/m^2), with HI women having a higher score. As per the exclusion criteria set, the HI group scored significantly higher on the restraint scale than the LO women.

Table 1: Demographic and psychometric measures.

Variable	LO	HI	statistic*	p
N	10	10	--	--
Age	29.3 ± 6.4	27.8 ± 7.3	0.24	ns
BMI (kg/ m^2)	20.3 ±1.4	24.0 ± 3.4	7.00	0.008
BDI	3.3 ± 2.5	5.3 ± 4.0	1.76	ns
Restraint	1.5 ± 1.0	9.8 ± 1.1	14.9	.0001

*Student's *t* test for Age and BDI df=18
*Wilcoxin X^2 for BMI and Restraint df=1

3 SALIVARY MEASURES

Results for salivary response across both time and condition are illustrated in Figure 1

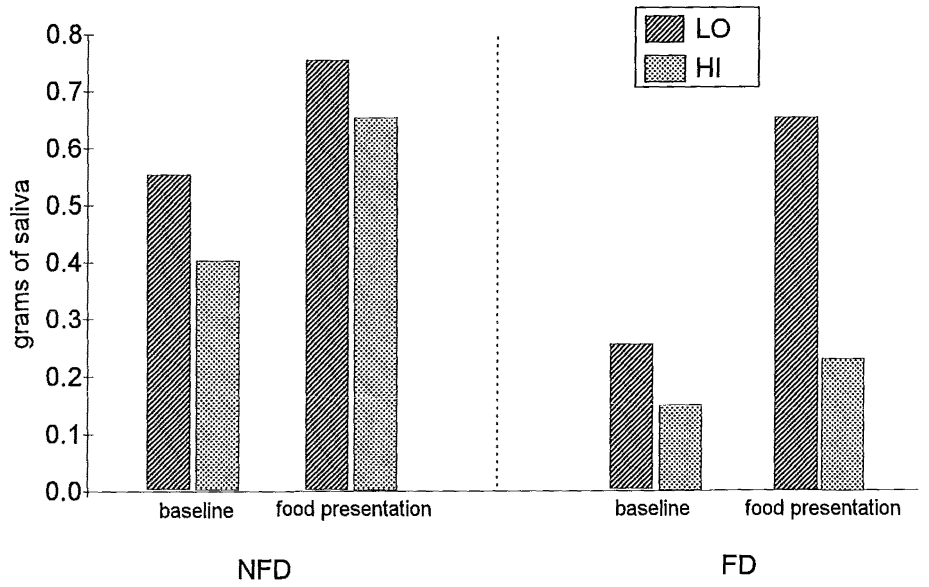

FIGURE 1. Salivary reactivity (gms) in low-restrained (LO) (n=10) and high-restrained (HI) (n=10) subjects when non-food-deprived (NFD) and food-deprived (FD), both at baseline and at food presentation. Values represent the mean of log transformed scores.

3.1. Baseline Measures. There was no significant difference across the HI and LO women on salivation at baseline. In addition there was no significant main effect for condition and no significant interaction effect for group and condition.

3.2. Reactivity Measures. Salivary reactivity results are presented on Table 2.There was no significant main effect for condition. There was a trend towards an interaction effect for group and condition [$F(1,18)=3.57$ $p< .08$]. While there was very little change in saliva reactivity in the LO group (NFD=0.25 $\pm$ 0.34; FD= 0.26 + 0.48) the HI women had a

reduced saliva reactivity on the food-deprived day (NFD=0.41 ± 0.22; FD= 0.15 ± 0.44).

Table 2. Saliva Reactivity

	Diagnosis and Condition				*p*		
	LO(10)		HI (10)				
Variable	NFD	FD	NFD	FD	Group	Condition	Group/ Condition
Saliva (g)	0.25±0.34	0.26±0.48	0.41±0.22	0.15±0.44	ns	ns	ns

4. SELF-REPORT SCALES

Results for the self-report scales are presented in Table 3.

4.1. Baseline measures.

While there were no significant differences across the two groups for the urge to binge, there was a significant main effect of condition on this variable [$F(1, 18)=5.1$, $p<.04$]. There was no main effect for group on the urge to eat scale. There was, however, a main effect, for condition [$F(1, 18)=29.2$, $p<.0000$] and a significant group x condition interaction [$F(1,18)=4.6$, $p<.05$]. There were no significant

main effects or interaction effect for SUDS. There was a significant main effect for group on feelings of fatness with HI women consistently reporting higher fatness ratings [$F(1,18)=.31$, $p<.03$].

4.2. Food Presentation Measures.

While there were no significant differences across the two groups for urge to binge, there was a significant main effect of condition on this variable [$F(1, 18)=.81$, $p<.02$]. However, there was no interaction effect. There was a main effect for condition on urge to eat scores. [$F(1,18)=5.19$, $p<.0008$].There was no significant interaction effect, on this variable. There was no significant main effect or interaction effect for scores of anxiety. There was a main effect for group on scores of feelings of fatness [$F(1,18)=.31$, $p<.03$]. There was no significant interaction effect on this variable. There was no significant main effect for smell, but there was a significant interaction effect on this variable [$F(1,18)=5.84$, $p<0.03$].

Table 3. Self-Report Scales

	Diagnosis and Condition				*p*		
	LO(10)		HI (10)				
Variable	NFD	FD	NFD	FD	Group	Condition	Group/ Condition
Baseline.							
Urge to binge	0.2 ± 0.42	2.1 ± 2.72	1.5 ± 2.51	3.3 ± 3.6	ns	.04	ns
Urge to eat	2.5 ± 1.96	6.2 ± 1.69	2.4 ± 2.22	4.0 ± 2.1	ns	.0000	.05
SUDS	1.2 ± 1.23	1.3 ± 2.11	1.8 ± 2.39	2.8 ± 2.5	ns	ns	ns
Fatness	1.49 ±0.47	1.3 ± 1.88	2.9 ± 1.91	3.1 ± 2.3	.03	ns	ns
Food Presentation							
Urge to binge	0.9 ± 1.66	2.1 ± 2.2	2.6 ± 2.5	3.3 ± 3.56	ns	.01	ns
Urge to eat	4.0 ± 2.21	6.2 ± 1.8	4.8 ± 2.4	5.7 ± 2.49	ns	.0008	ns
SUDS	0.8 ± 1.62	1.3 ± 2.6	2.6 ± 2.5	2.5 ± 2.71	ns	ns	ns
Fatness	1.1 ± 1.71	1.5 ± 1.4	3.4 ± 1.8	3.0 ± 2.26	.03	ns	ns
Smell	4.6 ± 1.78	5.9 ± 1.6	5.3 ± 1.4	4.9 ± 1.73	ns	ns	.03
Reactivity to food presentation (Food Presentation -Baseline)							
Urge to binge	0.7 ± 1.34	0.03 ± 1.06	1.1 ± 1.6	0.09 ± 1.92	ns	ns	ns
Urge to eat	1.5 ± 1.84	0.05 ±1.08	2.4±1.71	1.7 ±1.57	ns	.04	ns
SUDS	-0.4 ± 1.71	0.00 ± 0.47	0.8 ±1.23	-0.3 ± 0.92	ns	ns	ns
Fatness	-0.5 ± 1.26	0.2 ± 0.63	0.6 ± 0.85	-0.1 ± 0.57	ns	ns	ns
Post food consumption.							
Enjoy	6.3 ± 1.56	7.2 ± 1.14	6.3 ± 1.56	6.5 ± 1.84	ns	ns	ns
Guilty	1.6 ± 2.12	1.7 ± 2.5	1.6 ± 2.12	4.1 ± 2.73	.009	ns	ns
Fatness	1.9 ± 2.12	2.4 ±2.41	1.9 ± 2.12	4.7 ± 2.36	.007	ns	ns
Satis-faction	2.9 ± 2.92	1.1 ± 2.28	2.9 ± 2.92	2.3 ± 2.71	ns	.001	ns
SUDS	0.2 ± 1.42	0.1 ±0.31	0.20 ± 1.4	3.1 ± 2.6	ns	ns	ns

4.3. Reactivity (Food Presentation-Baseline)

Reactivity measures were calculated by subtracting the food presentation measures from the measures scored at baseline. The urge to eat was significantly higher in the no-food-deprived condition [F(1,18)5.2=p<.04]. There was no significant main effect or interaction effect for scores of urge to binge, SUDS or feelings of fatness.

4.4. Post Food Consumption.

HI women had a significantly higher mean score on feelings of guilt [F(1,18)8.5=p<.009] and feelings of fatness [F(1,18)9.4=p<.007]. While there was no main effect for group, people were more satisfied with the amount eaten on the non-food-deprived day [F(1,18)15.49=p<.001].

5. AMOUNT OF CALORIES CONSUMED

5.1 The Amount of Calories Consumed and Restraint

Results comparing the amount of calories consumed in the HI and LO women are presented in Table 4.

Table 4. Amount of Calories Consumed

	Diagnosis and Condition				p		
	LO(10)		HI (10)				
Variable	NFD	FD	NFD	FD	Group	Condition	Group/ Condition
Calories	59.73+27.1	76.41+22.8	85.4+15.3	71.95+19.9	ns	ns	.006

There was no main effect for group or condition. There was, however, a significant interaction effect [$F(1,18)=9.95$, $p<.006$], with HI women having a significantly higher mean score on the non-food-deprived day (X^2,5.1584 =$p<.02$) and LO women having a slightly higher mean score on the food-deprived day.

5.2. Amount of Calories and Salivation

Overall, on the non-food-deprived day salivation was not significantly correlated with the amount of calories consumed (r=0.13, ns) and on the food-deprived day there was a non-significant negative correlation (r= -0.14, ns).

When considering restraint, the salivary reactivity of the LO group was not significantly correlated on the non-food-deprived day (r= -0.09, ns) or the food-deprived day (r=0.07, ns). Salivary reactivity was

not correlated with amount consumed in the HI group also (NFD: r=0.16, ns; FD; r=-0.44, ns).

CHAPTER FOUR

DISCUSSION

This laboratory study of women dieters and non-dieters, investigated salivary, cognitive and emotional responses to palatable food cues under conditions of food-deprivation and non-food-deprivation.

1. Salivary Reactivity and Deprivation.

Overall, salivary reactivity differed very little between the high-restrained and the low-restrained women. However, there was a trend for a significant difference between these groups across the food-deprived and non-food-deprived conditions, with the high-restrained eaters salivating more on the non-food-deprived day and less on the food-deprived day, while the low-restrained eaters remained much the same over both conditions. Not only this, but, when comparing both groups, high-restrained eaters salivated more on the non-food-deprived day than the low-restrained eaters and low-restrained eaters salivated more on the food-deprived day. However these differences between the two groups were greater on the non-food-deprived day, with less differences in mean scores occurring on the food-deprived day.

The results of this present study disconfirm the hypothesis that the effects of the deprivation produced by the fast would be less noticeable in the high-restrained eaters. The formulation for this

hypothesis was based on the idea that restrained eaters would be likely to be restricting their diet, before the experimental session. However, only 20 per cent of the restrained eaters reported being on a diet to lose weight. This illustrates an issue raised by Lowe (1994) which suggests that restraint does not necessarily equate with dieting.

According to the tenets of the Restraint Theory (Herman & Mack, 1975), it would be expected that an increase in restraint (as on the food-deprived day) would correspond with an increase in salivation (that is, hyper-responsiveness). Yet, in this study, low-restrained eaters salivated much the same, while high-restrained eaters salivated less, when food-deprived.

A conditioning model may provide a more heuristic explanation of these findings. Since dieters more often experience sudden and extreme changes in their eating pattern with frequent periods of starvation followed by periods of binges, then two variable-ratio, intermittent schedules of reinforcement are most likely to be operating. Under such a model, if food cues predict intake (as in a disinhibited phase of a dieting cycle) then this re-pairing of events produces a spontaneous recovery of the salivation response with high rates of responding (e.g., increased salivation to food). If, however, food cues are not likely to predict intake (as in a restricted phase of the cycle), then this re-pairing of events is likely to produce spontaneous recovery of very low rates of responding (e.g. lowered salivation since food intake is not

likely). The trends indicated in this study tentatively support such a hypothesis. Restrained eaters had a higher salivary reactivity to food when normally satiated, but when deprived of food, these rates of responding were markedly less than those of their low-restrained counterparts.

When considering the non-food-deprived condition only, these results do compare favourably with those of Bulik et al. (submitted, a). In their study, they reported that there was no significant difference between salivary reactivity in high- and low-restrained women. However, when considering the effect of food-deprivation, the present findings are in contrast to a study by Sahakian et al. (1981). They found that salivation was positively related to scores on the restraint scale when subjects fasted for 17 hours. The disparity of findings are likely, in part, to be a function of the different methodologies utilised. In the study by Sahakian et al (1981) not only were subjects tested together in one large room, but, in addition, the method of measuring salivary reactivity was novel, and involved "emptying their mouths of saliva" (into a cup) (211: 1981).

2. Cognitions and Emotions

Not surprisingly, the results from this study reveal that baseline feelings of fatness were significantly higher in the restrained women and these differences were sustained during food presentation and post food

consumption. The significant difference across groups on the levels of guilt with restrained eaters having a higher mean score, was also expected and is in line with the type of cognitions recognised in dieters.

The results of the self-reported urges to binge were unexpected. Scores across both groups were not significantly different. It is possible that the definition of what constitutes a binge episode may differ from the technical term used within the literature and mental health settings. Research by Beglin and Fairburn (1992) suggested that a lay persons definition of a binge places more emphasis on the loss of control around food, rather than on the amount of food eaten.

The results from this study also revealed that the urge to eat for both groups was higher on the food-deprived day. The only significant difference between the groups occurred across conditions at baseline. Low-restrained women had a much higher urge to eat on the food-deprived day. Two explanations are likely. It is possible that the effects of an externally imposed diet restriction has impacted on dieters' perceived sense of achievement, and resulted in an increased motivation and sense of confidence to maintain diet boundaries. In this case cognitive processes may have helped over-ride the physiological hunger cues. Another explanation, is that the increased exposure to a food-deprived state experienced by dieters as part of a long term dieting history may have resulted in physiological adaptive processes to the lowered energy intake.

Smell was significantly different across the groups for the different conditions, with low-restrained eaters orientating less to food odours on the non-food-deprived day and high-restrained eaters orientating less on the food-deprived day. Hypotheses formulated on the basis of the Restraint Theory (Herman & Mack, 1975) suggest that restrained eaters would orientate more to external food cues than would unrestrained eaters. It would be expected that as restraint increases (as on the food-deprived day), then the orientation to external cues such as smell would also increase. However, in the present study the reverse was found, with restrained eaters reporting less smell when food-deprived. Similar results were reported in a study by Piacentini et al. (1993). Piacentini advanced a cognitive model to explain their results. They asserted that dieters adopt an "instructional set to disattend" (137:1993). They explain that restrained eaters appear to use active cognitive methods to reduce the salience of food stimuli.

Self-reported anxiety was not significantly different between the two groups, or across the two conditions. The results for the non-food-deprived condition are similar to those results reported by Bulik et al. (submitted, a) where no difference was found between low- and high-restrained eaters. Others propose that there is a positive relationship between restraint and the level of anxiety when exposed to food cues (Rogers & Hill, 1989; Rosen; 1981). Interestingly, Ogden and Wardle (1991) found the reverse pattern, post food consumption. In their study

they found that restrained subjects showed a significant reduction in their feelings of anxiety after the high-calorie food. They applied a cognitive dissonance model to explain how dissonance is created between desired and actual behaviour when restrained from food and that with the consumption of food, anxiety reduces.

When considering the 17 hour food-deprived condition, no comparable results from other studies were available. Sahakian et al.(1981) did not measure self-reported anxiety and Piacentini et al. (1993) used skin conductance measures to measure reactivity to food. Since skin conductance measured tonic sympathetic arousal, it is difficult to know whether they were measuring reactivity to food, anxiety, or both.

3. Salivary Reactivity and Calories Consumed

Results reveal that the two groups consumed a significantly different amount of calories on the food and non-food-deprived day, with restrained women consuming more calories on the non-food-deprived day and low-restrained eaters eating more calories on the food-deprived day. There was also a larger variation between groups in the amount of calories consumed on the non-food-deprived day, and minimal variation on the food-deprived day.

If an analogy can be made between a high-calorie preload and the non-food deprived condition and between a low-calorie preload and the non-food-deprived day, then the results of this study would support

the tenets of the Restraint Theory (Herman & Mack, 1975) which reports that restrained subjects tended to overeat following a preload identified as high-calorie, but ate rather little in a preload identified as low-calorie.

In addition, the results of the present study reveal that salivary reactivity and consumption for both the low-restrained and the high-restrained groups, were not significantly correlated, both on the food-deprived and non-food-deprived day. The results of this study are similar to those of Klajner et al. (1981).

In accordance with the conditioning model, intake can predict subsequent salivary responses, since the pairing of a conditioned stimuli with a conditioned response either strengthens this relationship in, for example, a case of a bulimic pattern of eating, or weakens this relationship in, for example, a restricted pattern of eating. However, while intake may predict subsequent salivation, research by Jansen et al. (1992) and the present data confirms that salivary reactivity does not necessarily correlate with intake. In accordance with Pavlovs findings, salivation may not necessarily reflect a hunger state, but may indicate that attention is focused on the food.

If it is correct to assume that hunger will predict intake, at least with the low-restrained subjects, then the present data therefore provides confirmatory evidence that the salivary reactivity to a food stimulus is more than just a response to a physiological hunger drive.

4. Limitations

This study does have distinct limitations.

The data were based on a small number of subjects. The preliminary significant findings and suggested trends found are, therefore, only tentative and will need to be followed up with research utilising larger sample sizes.

While, some subjects reported that they did not reduce their water intake during the fast, it is possible that increased dehydration may have occurred, which, while perhaps not affecting the difference between the groups, may have played a contributing role in the different salivary reactivity ratings across conditions.

One of the most serious limitations is that the concept of restraint is a topic of much debate. Recent research indicates that those individuals identified as restrained are a heterogenous group (Eldredge, 1992; Lowe, 1994 and Ogden & Wardle, 1991). More recently, varying factors include the current dieting status of subjects (Lowe, 1994), and level of self-esteem (Polivy & Herman, 1991; and Eldredge, 1994). The fact that this study failed to discriminate these factors may have obscured the findings. Moreover, this study failed to discriminate gender and ethnic differences. While only women were included in the sample studied, body image preoccupations and dieting behaviour does occur in a small portion of the male population (Hsu, 1990). A question to address in future research is whether the physiological, cognitive and emotional

responses in these male restrained eaters are similar to their restrained female counterparts, when food-deprived. In addition, eating attitudes and behaviour differ across ethnic groups. However, since only one woman in this study was non-Caucasian, this limited the ability to investigate the exact nature of this relationship.

Finally, and perhaps most fundamentally, salivary response may still, at best, only be a moderate indicator of the type of physiological response a person has to food. Until there is an increased understanding of the exact nature of salivation and hunger/satiety then the sensitivity of the power of salivation to predict physiological responses to food should be used with caution.

4. Future Research

Since a small number of subjects were examined in this study, and of these, only approximately 20 per cent of restrained women in the present study (similar to the 30 % of restrained women reported in a study by Lowe, 1994) were currently on a diet to lose weight, the subject sample size would have been too small to justify statistical analyses. A question, therefore, to be addressed in future studies would be whether these sub-groups of restrained eaters have different physiological responses under periods of food-deprivation. The formulation of a hypothesis on the potential difference between these two groups of restrained eaters are based on a self-efficacy model of restraint. Recent

literature (Ogden and Wardle, 1991; Polivy and Herman, 1991; Eldredge, 1993 and Lowe, 1994) emphasises the distinction between successful and unsuccessful restrainers, that is, between dieters who maintain a dietary restriction (and consequently have increased self-efficacy) and those who abandon attempts to reduce their intake (which is likely to decrease self-efficacy). According to this model, Lowe hypothesised that "restrained eaters who are *not* currently dieting to lose weight will be most vulnerable to disinhibitory eating" (349: 1994). They tested this empirically and found that, as with the results reported in a study by Polivy and Herman (1991), restrained eaters who viewed themselves as better dieters, reduced their intake. Unfortunately, no studies have yet been done investigating how a physiological response to food, such as salivary reactivity, may differ between these sub-groups. Such information may help determine whether differences among restrained eaters are a function of their current dieting status, or a function of their previous dieting histories.

Self-efficacy is only one of a number of factors which highlight the heterogenous nature of the concept of dietary restraint. It has now been acknowledged that dietary restraint encompasses a large variation in eating behaviours (Tepper, 1992). In addition, while a dieter, over a lifetime, may display large fluctuations in eating behaviours, and while they may be in a constant state of flux, they usually only utilise some of these practices at one time. Such variations are likely to play an

important part in conceptualising an individual's eating pattern and, therefore, should be a consideration in future studies.

5. Conclusions

Overall, food-deprivation impacted on the responses of low-restrained and high-restrained women, differently, both at baseline and in response to food cues. Not only was there a significant difference between the two groups in self-report urge to eat scores across the conditions found at baseline, but there was also a significant difference between the groups in perception of smell when presented with food. Moreover, there was a trend for an interaction effect across group and condition for salivary reactivity. There was also a significant difference in calories consumed across both the low-restrained and high-restrained groups when non-food-deprived and food-deprived.

The present data demonstrate that, while under controlled dieting conditions, where all subjects are restricting their intake for a set time, responses between high-restrained eaters and low-restrained eaters differed in some cognitive, physiological and behavioural areas of functioning.

Since these dieters and non-dieters responded differently, when both participating in a food-deprived situation, the results may provide preliminary evidence that the different responses found in dieters are not, at least in part, a result of their current dieting pattern, but rather

a result of long-term dieting histories, basic personality features and/or biological mechanisms. Teasing out these differences has been an going, unresolved problem within the literature.

Such findings may highlight the extent of the problem for dieters, who are not only challenged by their dysfunctional cognitions and emotions associated with food, but are challenged also by the different physiological responses to food.

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APPENDIX A

University of Canterbury *Department of Psychology*

Consent Form: Human Salivary Response

Reason for Research

This study is designed to examine the effects of dieting on the human salivary response. We will be studying women who often diet as well as women who never diet. We are interested in how the salivary response after fasting and not fasting differs across these two groups of women. You have been invited to participate in this research because you do not have a history of an eating disorder, are a no-smoker, physically healthy and are medication free.

Your Task in this Research

You will be asked to participate in two short laboratory sessions on two different days. Each session should take approximately 30 minutes. Prior to this, you will be asked a few questions by the researcher regarding your attitudes towards food. You will also be asked to complete a short self-report form. If you are then invited to continue, on one occasion you will be asked to fast for a period of 17 hours and the other, to consume a

standard breakfast before participating in the experimental sessions. On each occasion you will be presented with a rich food. You will be asked to insert three dental rolls in your mouth- one under the tongue and two between your lower teeth and cheeks. As you look at and smell the food we will ask you to rate certain feelings on a 0-8 scale (e.g. How strong is your urge to eat?). Following presentation of the food, we will ask you to remove the dental rolls and place them in a small plastic bag for collection. You will then be asked to eat as much of the food as you can. the rolls will be weighed before and after the experiment to measure the amount of saliva you secrete.

Risks Associated with Participation

There are no foreseeable risks associated with participating in this experiment. The only possible discomfort is on the fasting day you will feel hungry. We do not expect this to cause you any problems. You will insert and remove the dental rolls yourself. Towlettes will be provided for handwashing prior to insertion. This procedure is familiar to most people from visits to the dentist's office.

Confidentiality

Complete confidentiality is assured. Numbers, not names, will be used on all experimental materials. When results of this research are published, no identifying information will be provided.

Voluntary Participation

Your participation in this research is completely voluntary. If at any time you choose to discontinue participation, you are free to do so at no cost to you.

Time Required

You will spend approximately 15 minutes in the lab today and 30 minutes on two separate occasions for the experimental procedure. You will be paid $10.00 for your participation.

Name of Researcher

Sandra Browne, B.A.

Name of Supervisor

Cynthia M. Bulik, Ph.D., Lecturer in Psychology

Voluntary Consent

I have read the contents of this consent form and understand them completely. I also understand the risks and benefits associated with

participation in this research. I realise that I am free to withdraw consent at any time and discontinue participation.

_____ _____

Signature of Participant Date

_____ _____

Signature of Investigator Date

APPENDIX B

Date..... Number.....

1. How often are you dieting ?

rarely sometimes usually always

2. What is your maximum weight gain within a week ?

_____

3. Do you eat sensibly in front of others and then make up for it when you are alone ?

never rarely often always

4. Do you give too much time and thought to food ?

never rarely often always

5. Do you have feelings of guilt after overeating ?

never rarely often always

APPENDIX C

BECK INVENTORY

No._____ **Date**_____

1 0 I do not feel sad
1 I am sad
2 I am sad al the time and can't snap out of it.
3 I am so sad or unhappy that I can't stand it

2 0 I am not particularly discouraged about the future.
1 I feel discouraged about the future
2 I feel I have nothing to look forward to.
3 I feel that the future is hopeless and that things cannot improve

3 0 I do not feel like a failure.
1 I feel I have failed more than the average person.
2 As I look back on my life all I can see is a lot of failures.
3 I feel like I am a complete failure as a person.

4 0 I get as much satisfaction out of things as I used to.
1 I don't enjoy things the way I used to.
2 I don't get real satisfaction out of anything any more.
3 I am dissatisfied or bored with everything.

5 0 I don't feel particularly guilty.
1 I feel guilty a good part of the time.
2 I feel quite guilty most of the time.
3 I feel guilty all of the time.

6 0 I don't feel I am being punished.
1 I feel I may be punished
2 I expect to be punished
3 I feel I am being punished.

7 0 I don't feel disappointed in myself.
1 I am disappointed in myself.
2 I am disgusted with myself.
3 I hate myself

8 0 I don't feel I am any worse than anybody else.
1 I am critical of myself for my weaknesses or mistakes.
2 I blame myself all the time for my faults.
3 I blame myself for everything bad that happens.

9 0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself but I would never carry them out.
2 I would like to kill myself.

12 0 I have not lost interest in other people.
1 I am less interested in other people than I used to be.
2 I have lost most of my interest in other people.
3 I have lost all of my interest in other people

13 0 I make decisions about as well as I ever could.
1 I put off making decisions more than I used to.
2 I have greater difficulty making decisions than before.
3 I can't make decisions at all any more.

14 0 I don't feel I look any worse than I used to.
1 I am worried that I am looking old or unattractive.
2 I feel that there are permanent changes in my appearance that make me look unattractive.
3 I believe that I look ugly.

15 0 I can work as well as before.
1 It takes an extra effort to get started at doing something.
2 I have to push myself very hard to do anything
3 I can't do any work at all.

16 0 I can sleep as well as usual.
1 I don't sleep as well as I used to.
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3 I wake up several hours earlier than I used to and can't get back to sleep.

17 0 I don't get more tired than usual
1 I get tired more easily than I used to.
2 I get tired from doing almost anything
3 I am too tired to do anything.

18 0 My appetite is no worse than usual.
1 My appetite is not as good as it used to be.
2 My appetite is much worse now.
3 I have no appetite at all any more.

19 0 I haven't lost much weight, if any, lately
1 I have lost more than 5 pounds.
2 I have lost more than 10 pounds.
3 I have lost more than 15 pounds
I am purposely trying to lose weight by eating less. Yes____ No____.

20 0 I am no more worried about my health than usual.

3 I would kill myself if I had the chance.

10 0 I don't cry any more than usual.
1 I cry more now than I used to.
2 I cry all the time now.
3 I used to be able to cry, but now I can't cry even though I want to.

11 0 I am no more irritated now than I ever am.
1 I get annoyed or irritated more easily than I I used to.
2 I get irritated all the time now.
3 I don't get irritated at all by the things that used to irritate me.

1 I am worried about physical problems such as aches and pains; or upset stomach; or constipation.
2 I am very worried about physical problems and it is hard to think of much else.
3 I am so worried about my physical problems that I cannot think about anything else.

21 0 I have not noticed any recent change in my interest in sex.
1 I am less interested in sex than I used to be.
2 I am much less interested in sex now.
3 I have lost interest in sex completely.

APPENDIX D

ID_____DATE_____CONDITION_____NUMBER__1_

PLEASE CIRCLE THE NUMBER THAT BEST DESCRIBES HOW YOU ARE FEELING **RIGHT NOW.**

1. HOW STRONG IS YOUR URGE TO EAT ?

0	1	2	3	4	5	6	7	8
NOT AT ALL								VERY STRONG

2. HOW STRONG IS YOUR URGE TO BINGE ?

0	1	2	3	4	5	6	7	8
NOT AT ALL								VERY STRONG

3. HOW ANXIOUS ARE YOU ?

0	1	2	3	4	5	6	7	8
NOT AT ALL ANXIOUS								VERY ANXIOUS

4. HOW FAT DO YOU FEEL ?

0	1	2	3	4	5	6	7	8
NOT AT ALL								VERY FAT

5. HOW CONFIDENT ARE YOU THAT YOU COULD RESIST THE URGE TO EAT ?

0	1	2	3	4	5	6	7	8
EXTREMELY CONFIDENT								NOT AT ALL CONFIDENT

ID_____ DATE_____CONDITION_____NUMBER__2_

PLEASE CIRCLE THE NUMBER THAT BEST DESCRIBES HOW YOU ARE FEELING **RIGHT NOW.**

1. HOW STRONG IS YOUR URGE TO EAT ?

0 1 2 3 4 5 6 7 8
NOT AT ALL — VERY STRONG

2. HOW STRONG IS YOUR URGE TO BINGE ?

0 1 2 3 4 5 6 7 8
NOT AT ALL — VERY STRONG

3. HOW ANXIOUS ARE YOU ?

0 1 2 3 4 5 6 7 8
NOT AT ALL ANXIOUS — VERY ANXIOUS

5. HOW CONFIDENT ARE YOU THAT YOU COULD RESIST THE URGE TO EAT ?

0 1 2 3 4 5 6 7 8
EXTREMELY CONFIDENT — NOT AT ALL CONFIDENT

6. HOW STRONG DOES THE FOOD SMELL ?

0 1 2 3 4 5 6 7 8
NOT AT ALL — VERY STRONG

ID_____ DATE_____CONDITION_____NUMBER__3_

PLEASE CIRCLE THE NUMBER THAT BEST DESCRIBES HOW YOU ARE FEELING **RIGHT NOW.**

1. HOW MUCH DID YOU ENJOY THE FOOD ?

0	1	2	3	4	5	6	7	8
NOT AT ALL								VERY MUCH

2. HOW GUILTY DO YOU FEEL ABOUT THE AMOUNT YOU HAVE EATEN ?

0	1	2	3	4	5	6	7	8
NOT AT ALL GUILTY								VERY GUILTY

4. HOW FAT DO YOU FEEL ?

0	1	2	3	4	5	6	7	8
NOT AT ALL								VERY FAT

4. HOW SATISFIED DO YOU FEEL ABOUT THE AMOUNT YOU HAVE EATEN ?

0	1	2	3	4	5	6	7	8
NOT AT ALL								VERY SATISFIED

3. HOW ANXIOUS ARE YOU ?

0	1	2	3	4	5	6	7	8
NOT AT ALL								VERY ANXIOUS